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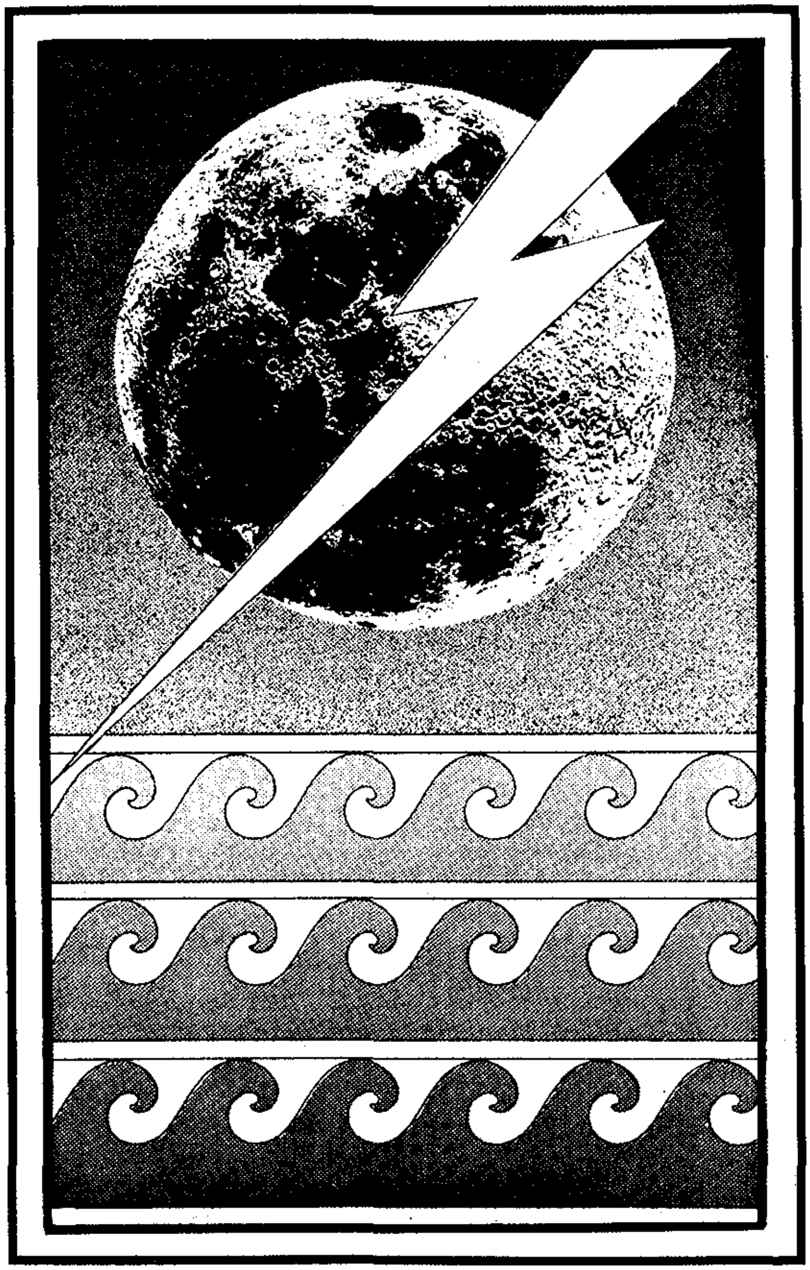

THE INTERNATIONAL PASSAMAQUODDY TIDAL POWER PROJECT AND UPPER SAINT JOHN RIVER HYDROELECTRIC POWER DEVELOPMENT

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Ancient Arabian, Chinese, and Icelandic scholars pondered the mystery of the tides for many centuries before the coming of Christ. In the reign of Augustus Caesar, Strabo--a Greek philosopher residing in Eygpt--correctly correlated the rise and fall of the tides to the movement of the moon.

The tides have long been envisioned as a source of power. As early as the 11th century, tidal mills were built in Europe and England to grind grain. By 1617, a tidal grain mill was constructed in New England.

In 1919, Dexter Cooper, an eminent engineer of his day, stood on the shores of Passamaquoddy Bay which separates the United States and Canada. Here, he would build the world's first tidal power plant to generate electricity. From 1919 to 1934, he pursued his dream.

President Franklin D. Roosevelt in 1935 allocated $7 million to the U.S. Army Corps of Engineers to start construction of Passamaquoddy. President Roosevelt, who often sailed in Quoddy Bay and whose home on Campobello Island is now an international park, shared the vision and foresight of Dexter Cooper.

However, amid catcalls of "boondoggling," Congress in the following year refused to appropriate funds for further construction.

Since Roosevelt and Cooper

Both Cooper and Roosevelt were ahead of the times.

However, Passamaquoddy and the scientific challenge of harnessing the tides continued to capture the scientific imagination.

In 1941, the Federal Power Commission reported to the Senate that a tidal power plant, developed solely in U. S. waters, was not competitive with potential run-of-the-river hydroelectric sites in Maine. The Commission, however, pointed out that this conclusion should not preclude "thorough examination" of the possibilities of a large international tidal power project through U.S.-Canadian cooperation.

From 1956 to 1961, the International Joint Commission conducted a detailed investigation of the engineering and financial feasibility of a joint Canadian-U.S. Passamaquoddy International Tidal Power Project.

The IJC engineering board reported, "A tidal power project using the waters of Passamaquoddy and Cobscook Bay can be built and operated. The two-pool type of project is best suited for site conditions in the area and the power markets it would serve. The tidal project arrangement selected makes the best use of the site conditions." The board also recommended integration of a hydroelectric site on the St. John River with the Quoddy project and said this combination is "economically justified" if built entirely by the United States, giving the project a cost-benefit ratio of 1.10 to 1--if constructed at U. S. interest rates.

However, the full International Joint Commission did not find the project economically feasible "under present conditions," principally because of:

--The unfavorable interest rate which would apply under joint U. S.-Canadian construction.

--The assumed method of operation as a base-load plant for continuous around-the-clock electric generation.

In making its recommendation, the Commission said, "The Commission wishes to point out that the economic feasibility of the project may be affected by future changes in the costs and benefits considered in the present evaluation. The two Governments may wish to give consideration to the desirability of crediting the tidal project with certain benefits that have not been included in the economic feasibility determination presented in this report."

Passamaquoddy Today

In May 1961, Senator Edmund S. Muskie of Maine issued the following statement:

"The conclusions and recommendations of the International Joint Commission on the proposed Passamaquoddy Power Project will require the most careful and rigorous analysis. In my opinion, the joint engineering board report and the Commission's recommendations should be treated as the basis for discussion in planning a program of sound utilization of the power resources of the Maine-New Brunswick area.

"I am recommending to the President that the Administration explore all unanswered questions in the report, and that serious attention be given to those suggestions made by the Commission which would affect a final determination on the feasibility of the project.

"Imagination, patience, and sustained effort will be required to achieve effective utilization of the power resources of the area covered in the Quoddy report. Although there may be differences of opinion as to the validity of its assumptions, the Commission's report does provide a checkpoint from which we can move in planning for the future."

Subsequently, the late President John F. Kennedy asked Secretary of the Interior Stewart L. Udall to evaluate the IJC report. The President asked Secretary Udall to investigate changes which "might result in making the project economically feasible." President Kennedy also noted that the Passamaquoddy Project "has challenged engineers and students of water resources for many years, and I am hopeful that the current (IJC) report..... can be as useful as possible in formulating a sound policy for the development of resources in the area covered by the report."

The Turning of the Tide

Secretary Udall immediately created a six-man Passamaquoddy-St. John River Committee and appointed Morgan D. Dubrow, chief engineering adviser and assistant to Assistant Secretary Kenneth Holum, Water and Power Development, as chairman. Mr. Holum has supervised the work of the Committee over the past three years.

The Committee has at its disposal the engineering and technical talents of the Department of the Interior's Bureau of Reclamation which has developed water and power resources in the western United States for over sixty years. The Bureau's vast engineering center and staff in Denver, Colorado, was made available to the Committee.

Also, the Committee utilized the extensive abilities of the U. S. Army Corps of Engineers--the Nation's oldest and largest "engineering firm" whose construction accomplishments have won the praise of engineers throughout the world. As a footnote to history, among those from the Corps who contributed their talents to the assignment was John W. Roche. Nearly 30 years ago, Mr. Roche--a native of Maine--worked on the Quoddy project initiated by President Roosevelt.

This array of engineering talent went to work.

Quoddy Is Feasible

"The time is at hand for America to fulfill man's centuries-old dream of harnessing the tides. The place is Passamaquoddy Bay on the U.S.-Canadian border between Maine and New Brunswick," the Passamaquoddy-St. John River Study Committee reported in July 1963.

"The project is feasible from an engineering and economic viewpoint. The benefit-cost ratio is 1.27 to 1....costs are repayable within 50 years after each power unit becomes revenue producing," the Committee said, also pointing out that prescribed Federal interest would be paid during construction and amortization of this natural resource investment.

Why Feasible After 45 Years?

As stated earlier, the International Joint Commission's 1961 report found that the Passamaquoddy-Upper St. John Development was not financially feasible--although engineeringly sound--chiefly because of the differences between public financing rates of the United States and Canada. The Commission, recognizing that changing conditions could affect its findings stated that it "wishes to point out that the economic feasibility of the project may be affected by future changes in the costs and benefits considered in the present evaluation."

And, this is precisely what happened. From the time the International Joint Commission initiated its study and through its completion, vast changes were taking place in electric transmission and generating technology which were not available for consideration by the Commission. Furthermore, these technological changes were--and still are--affecting the marketing and economics of power generation.

First, based on data provided by the Federal Power Commission and the New Brunswick Electric Power Commission, a load and resources study was made of the logical marketing area.

This study showed that by 1980, some 36 million kilowatts of electric power capacity will be required in the New England-New Brunswick area, and only about 13 million kilowatts of this needed capacity was planned. Further, the demand for peaking power--the most valuable of all classes of power--would increase to about 2 million kilowatts by 1970 and to about 4 million kilowatts by 1980.

Based on this new knowledge, it became apparent from an engineering and economic viewpoint to change the concepts previously used in studying the Quoddy-Upper Saint John Development. The utilization of Quoddy's tides had always been applied to conventional around-the-clock generation base load of electricity--thus limiting Quoddy's installed capacity to about 300,000 kilowatts of which some 95,000 kilowatts was dependable power. By changing the basic concept of the project, the same amount of water can yield 1,100,000 kilowatts of peaking power, approximately 200,000 kilowatts of base-load power, plus substantial generation of off-peak energy, when combined with the Dickey Dam area on the Upper Saint John River. At this point, Quoddy becomes a regional development, not confined to the immediate area of Maine and New Brunswick.

Three other technological improvements now make the project desirable:

--the development of extra-high-voltage transmission lines.

--the development of axial-flow turbines which are more economic than earlier models considered.

--the trend toward utilization of thermal generating plants which must operate at maximum capacity to achieve maximum economic efficiency.

Today, public and private agencies are constructing and utilizing transmission lines of from 345,000 volts to 500,000 volts. The Quoddy-Saint John Project would utilize two 345,000 volt lines running from Dickey to Bangor, to Portland, and on to the Boston area. Three 230,000 volt lines would interconnect Quoddy with Dickey via Bangor.

The axial-flow turbine, which was still on the drawing boards during the International Joint Commission study, has decided advantages for tidal generation not available in earlier generators. This unit is more efficient in generation, is smaller in size, and is less costly to install. For example, four generators can now occupy the space allotted to three in previous studies, and offer better maintenance advantages.

The last of the technological advances is the trend toward highly efficient thermal units which operate at maximum rates of capacity.

These units, without a doubt, will eventually bring lower cost power to the New England area--and it makes no difference whether the source of heat is from coal, oil, gas or nuclear fuel.

However, these generators to produce power at the lowest cost must operate constantly at rated capacity, shutting down only for maintenance. This means steady around-the-clock generation, not peaking power.

Furthermore, the fine heat balances at the high pressures and temperatures which must be maintained to promote maximum efficiency make it highly risky, if not questionable, to use such generators only for peaking power--and highly expensive.

The point is simple: as the use of highly efficient thermal plants increases in New England and brings its lower costs, the need for flexible and efficient peaking plants--such as Quoddy--increases. Throughout the Nation, hydroelectric generation for peaking purposes is a concurrent modern trend.

Thermal Versus Quoddy--An "Electric" Herring

It has been properly claimed that the thermal unit can produce power at a cost of about seven mills per kilowatthour in New England. Therefore, it is argued that Quoddy power is not needed because it is more expensive. This argument is fallacious:

--First, it compares base load power, or constant generation, with peaking power. Peaking power is power needed over and above constant generation to meet daily upsurges in electric demand.

--Secondly, these units cannot produce peaking power for seven mills per kilowatthour--and this can be demonstrated by using the Mount Tom powerplant of the Holyoke Water Power Company at Holyoke, Massachusetts, as an example of thermal plant operated for peaking purposes. The plan is a highly efficient thermal plant, constructed in 1960, and one of the most efficient in New England today. Our comparisons are based on production costs of the plant as reported in 1961 to the Federal Power Commission.

The Mount Tom plant was constructed to operate at 95 percent of its capacity--about 8,330 hours annually or 22.8 hours daily on an annual average. Operated as intended, it does produce power at a rate of 7.16 mills per kilowatthour.

However, if it were operated for 12 hours daily on an annual average, its cost per kilowatthour would increase by 49 percent to 10.67 mills. On an average annual use of three hours per day, the cost would soar by about 300 percent to 32.91 mills. And, if operated for two hours per day--as Quoddy can be--the cost of this peaking power would be 56.4 mills, or an astronomical 800 percent higher than the oft-quoted seven mill figure.

Why? Because the fixed charges on any such plant are so great, that no utility--public or private--could afford to run it for two hours daily and the fact that the power would have to be priced at a prohibitively high rate in order to recapture the investment cost.

Here is a highly efficient thermal plant which is capable of generating seven mill power when operated as intended. As demonstrated above, when its costs are computed for use as a source of peaking power, and compared with Quoddy-Dickey delivered costs of 11.3 mills, the argument literally falls apart--even if a utility were so foolish as to risk their investment in such equipment for peaking use.

This analysis of the Mount Tom powerplant can be equally applied, for example, to Boston Edison Company's new Boston Station and the Connecticut Yankee Atomic Steam Plant.

Is Quoddy-Dickey Too Expensive?

Quoddy and the Upper Saint John project are criticized because of cost--$896 million. However, it is staged for construction over a period of about ten years--a level of expenditure certainly commensurate with investment in water resource development throughout the Nation.

New England power consumers have received leaflets stating that "If you multiply one silver dollar by a billion, you get an idea of how many of your dollars will be wasted if the Federal Government builds the Passamaquoddy Tidal Power Project in Maine."

What are the facts:

--First, 90 percent of the project's costs are repayable, with the prescribed Federal interest, from power sales--as generally prescribed for all Federal water resource projects. Each power feature must pay for itself in fifty years--and after which with only operation and maintenance cost the project will continue to generate extremely low cost electricity for generations to come. The remaining 10 percent of the cost is ascribed to national benefits--about five percent to outdoor recreation and about five percent to area redevelopment with a small amount allocated to flood control.

You cannot multiply one dollar by a billion to find any so-called waste. In fact, you can find no waste unless you feel that outdoor recreation, area redevelopment, and flood control are a waste.

A leading Federal official has said, of water resource development in general, "I sometimes wonder what has happened to our perspectives and our sense of values when this kind of prudent public investment is condemned with such epithets as 'pork barrel' and 'boondoggle' and worse ..... We will not grow while we let our natural resources lie untapped, while we fail to bring them into the service of our society, while we glorify the past and shut our eyes to our great future. There is no 'fiscal responsibility' when we refuse to count as assets our dams, our harbors, our river channels, our reclaimed land, and all the lives and property saved by flood protection. If we cannot tell the difference between waste and investment, we do not understand even the basic ABC's of economic growth.....

"The task of conserving and developing the Nation's resources is tremendous. Whether it is in the production of power, the management of forests and rangelands, the development of water resources, or the conservation of helium, there is enough for all of us to do--Federal, State, local and private organizations--if we are serious about it. Each group can accomplish certain tasks better than others. What we need to do is to get together."

All of the great water resource development projects in the Nation--Hoover Dam and Bonneville Dam, for example--were at one time or another labeled as economically infeasible. Time has demonstrated that these so-called "boondoggles" of the past are today most valuable economic assets which contribute to the prosperity of this Nation.

A prime example is the great Grand Coulee Dam on the Columbia River. Grand Coulee--whose power features will be repaid from power sales with interest in approximately 26 years--played an important role in World War II in supplying power for our essential aluminum industry. Today, Grand Coulee is a major feature in a joint cooperative public-private regional power system which has the lowest electric rates in the Nation.

Yet, Grand Coulee was once called the "most colossal fraud in the history of America" by a leading legislator of the day. It was viciously termed visionary, impractical, and a ruthless waste of public funds. It was assailed editorially as "impressive in the magnitude of its folly."

History has shown that the critics of Grand Coulee were wrong--and history will again demonstrate in New England that the optimum development of our water resources is sound public policy.

The Department of the Interior has--for over one-hundred years--been engaged in the development of the natural resources of many portions of this Nation. The Department knows from fruitful experience that resource development is an essential key to a healthy economy and a productive society. In case after case--in California, in the Pacific Northwest, in South Dakota and elsewhere--comprehensive water resource development has literally pumped new life into communities suffering from chronic economic stagnation.

The Human Side of Quoddy-Dickey

Washington County, the location of the Passamaquoddy Tidal Powerplant, d Aroostook County, where the Dickey site is located, have been declared areas of substantial and persistent unemployment. Washington County's population has declined for the decade 1950 to 1960, while Aroostook County's population increased only by 9.4 percent--as contrasted to a national growth rate of 19.2 percent.

Economic opportunity has been denied to the youth of both counties with subsequent migration to other cities and states, thus breaking down the traditional family solidarity characteristic of New England. Industry has moved to other areas, thereby causing many retail and service establishments to close. The high cost of electric power has been a significant contributing factor in the industrial decline of the area. Fish processing plants in Washington County--an important local industry--have gone out of business, and the county's agricultural economy has been declining. In Aroostook County, agricultural conditions are uncertain, and the lumber industry is subject to wide fluctuation.

A national sampling conducted by the Department of Labor in 1959 showed that an annual income of approximately $6,000 is required to maintain a modest but adequate level of living for a typical family of four. In Washington County, 34 percent of the families have incomes of less than $3,000 annually, and in Aroostook County over 30 percent of the families have incomes of less than $3,000. In Washington County, nearly 17 percent of the family units receive some form of public assistance, and in Aroostook County nearly 12 percent of the family units receive public assistance. Using this yardstick, one-third of the people in the area live in poverty, as contrasted with a national projection of one-fifth.

By providing substantial on-site employment, the Passamaquoddy-Dickey Project will do much to alleviate human misery. The area redevelopment values, however, go much further than employment opportunity. Furthermore, a rejuvenated economy normally follows completion of water resource projects.

More important, perhaps, for longer term is the new ray of hope which will be instilled in the people of the area--men, women, and children who have lived with a mounting sense of despair for years. The psychological exit from poverty provided by Quoddy-Dickey, as well as its material benefits, will again offer the self-reliant people of the area a new opportunity to advance themselves to the limits of their capabilities.

As Senator Edmund S. Muskie of Maine so aptly puts it, "It is now New England's turn at bat." For years the people of New England have vigorously supported resource conservation programs in other parts of the Nation.

The Exit from Poverty

Water resource development contributes to a healthy national economic environment. Local payrolls are created. For each worker involved in on-site construction, economic studies show that four additional Americans are generally employed in the manufacturing and transportation of materials.

Materials from every portion of the Nation will be utilized. To cite Trinity Dam in California as an example, tractors and conveyors came from Illinois, trucks from Indiana and Pennsylvania, steel from Ohio, generators from New York, cranes, shovels, and draglines from Wisconsin--plus a myriad of products produced under contract or subcontract from the vast industrial empire of the East, Americans in many parts of the country found gainful employment because Trinity Dam in California was constructed. The same has been true of Glen Canyon, Hungry Horse, Hartwell, and all the rest. The same will be true of Quoddy.

The Quoddy project and Dickey Dam, plus the backbone transmission line to Boston will provide nearly 15,000 man-years of employment in direct construction alone--not counting the jobs created to supply the vast quantities of materials needed for these projects.

The bulk of construction will take place in Maine--in two of the most seriously depressed counties in the Nation, but the impact of a multi-million construction job will be felt throughout New England and the Nation.

What kind of jobs will be needed?

The list is long--transportation workers, surveyors, plumbers, pipe-fitters, electricians, steel construction workers, carpenters, crane and excavating machinery operators, painters, mechanics of many varied skills, warehousemen, clerks, secretaries, concrete finishers, welders, powerlinesmen, and many others.

Tremendous quantities of materials will be required and it is reasonable to assume that the factories of New England will supply--

either under prime or subcontracts--much of this material as they have for many other projects across the Nation. Needed will be: Electrical and other wire products and accessories; steel pipe, tubing, and fittings; hardware; fabricated steel; cement and admixtures; building materials of many kinds; equipment and repair parts; lifting and transporting equipment; electric motors and controls; hand tools and work equipment; hydraulic equipment; and, of course, turbines and generators and transmission equipment.

Furthermore, the Quoddy-Boston transmission line--which could become an important part of an interconnected New England-New Brunswick electric grid system in the years ahead--will require much electrical equipment and many skills.

How Will The Job Be Done?

Following approval by the United States Congress and agreement with Canada, construction will begin on Dickey Dam, approximately a five-and-one-half year job. A year after Dickey gets under way, the small Lincoln School re-regulating structure will start. This dam can actually be considered as part of Dickey, although it is located further downstream.

About two years after the commencement of work at Dickey, construction will start on the locks, dams, and the first power house at Quoddy--a seven year job. Later, when market demand for electric power dictates, the second Quoddy power house will be started.

What are the comparative sizes and costs of these structures?

Dickey Dam--located above the confluence of the St. John and Allagash Rivers--will rise approximately 340 feet above the river bed, and it will be 9,200 feet across the top. Dickey will be a compacted earth and rock-filled dam requiring 65 million cubic yards of earth and rocks, 500,000 cubic yards of concrete, and 20,000 tons of reinforcing steel. Complete with generators, and power house, and other necessary features, the estimated cost is about $210.4 million.

The Dickey reservoir will cover 88,000 acres and have a total storage capacity of over 8,000,000 acre-feet of water. Of this, 2,900,000 acre-feet will be used for power generation and river regulation. One acre-foot is the equivalent of nearly 326,000 gallons. Incidentally, usable water storage at the Dickey site exceeds the storage capacity of the abandoned Rankin Rapids site by 100,000 acre-feet. This site would also have flooded the 100-mile length of the famed Allagash River.

Dickey will generate 250,000 kilowatts of base-load power with the firming contribution of Quoddy. River regulation made possible by Dickey will generally assure a level of about four feet of water in the St. John at all times. This will eliminate those times when the river virtually runs dry during periods of low flow. In addition, the regulation of river flows will result in an additional 600 million kilowatt hours of potential generation at hydroelectric plants downstream in Canada.

Lincoln School is a small dam which will be built in conjunction with Dickey, and provide a re-regulating reservoir. This will help to further regulate the flows out of Dickey powerplant.

Contrasted with Dickey, Lincoln School is small. Costing $16.6 million, it will be 87 feet high and 1,290 feet across. The cost includes a 34,000 kw powerplant. Its reservoir of 2,200 acres will provide 16,000 acre-feet of usable storage. Lincoln School will require 2.2 million cubic yards of earth and rock, 85,000 cubic yards of concrete, and 4,000 tons of reinforcing steel.

By far, Quoddy is the largest of the three. It will have nearly seven miles of earth and rock-filled dams, 90 filling gates, 70 emptying gates, and four navigation locks.

To build Quoddy, we will use 117 million cubic yards of earth, rock, and excavated materials, 2,650,000 cubic yards of concrete, and 402,000 tons of various types of steel. The cost: about $582 million.

The transmission grid system--requiring 3,000 miles of conductor together with towers and related equipment--will cost $87 million.

Are There Alternatives to Quoddy

The Passamaquoddy-Upper Saint John Project is singularly unique in its potential for providing immediate beneficial economic impact and sustained economic benefit for the people of seriously distressed areas of Maine and New Brunswick--areas which compare to any other region in both countries in the roots and consequences of prolonged poverty.

For the first time in history, this engineeringly imaginative and conclusively demonstrable economic water resource development will provide Canada, the United States, with full-scale generation of electric power from the tides of the ocean. In addition, it will encompass comprehensive development of an important international river in the Northeast, an unparalleled international recreational attraction, and significant and continuing new employment opportunities directly and indirectly.

Power, however, is a major feature and function of the project. From this source comes the revenues which must repay the basic cost of natural resource development, as well as the costs of operation, maintenance, replacement, and interest--the requirements of Federal policy and Congressional directive for water resource development.

In order to evaluate properly the value of power from the Passamaquoddy-Upper Saint John Project, a comparison of the cost of power generated by likely alternative sources, in conjunction with due regard for their alternate merits and demerits, were considered.

The first, and more probable equivalent alternative, would be a modern steam generating plant fired by fossil fuels and operated to provide equivalent power.

Although it was recognized that conventional hydroelectric powerplants, jet engine peaking plants, gas turbine peaking plants, steam topping units or diesel engines are also peaking power sources, the Committee concluded that for the purpose of evaluating power of the magnitude, and characteristic of flexibility and perpetuity of the Passamaquoddy-Dickey Project, that these other alternative sources could not provide peaking power of the magnitude offered by the Passamaquoddy-Saint John River Project, either on a historical basis in New England in case of conventional hydroelectric power or by long-term operating experience in the case of other alternatives mentioned above.

Comparison was restricted to thermal plants, both fossil fuel and nuclear fired, and conventional pumped storage plants.

Analysis of Alternatives

Economic analysis alone precludes all privately financed fossil fuels, nuclear, or pumped storage projects as an alternative to the Passamaquoddy-Upper Saint John River Project. In no instance of feasible alternatives can privately financed electric generation provide an equivalent amount of power at lower cost. The economic alternatives are as follows:

--<u>Federal Steam Plants.</u> The charges of $13.90 for capacity and 3 mills for energy are less than the equivalent cost for the Passamaquoddy-Upper Saint John River Project. However, no legislative authority exists for the Corps of Engineers or the Department of the Interior to construct or operate conventional steam plants in the continental United States; nor has the Congress elected to adopt such a policy. In any event, this alternative offers no development of regional water resources as specified in Senate Document 97, 87th Congress; nor does it provide any significant area redevelopment or outdoor recreational benefits comparable to the Passamaquoddy-Upper Saint John River Project. And, in the analysis, a Federal steam plant so operated would be inefficient to provide power such as that available from the Passamaquoddy-Upper Saint John Project.

--<u>Federal Nuclear Power.</u> A Federally financed and operated nuclear powerplant could again under certain conditions supply power of the same magnitude at a lower cost. However, legislative history provides conclusively that the Congress does not envision wholly-financed and wholly-operated Federal nuclear plants. Furthermore, a Federal nuclear plant would not result in any water resource development, flood control, river regulation, area redevelopment, or outdoor recreational benefits. Again, as in the case of a Federal steam plant operating on fossil fuels, a Federally owned and operated nuclear powerplant would have to be operated uneconomically to provide equivalent power.

--<u>Pumped Storage.</u> Federally constructed and operated pumped storage projects could produce equivalent peaking power at a lower cost than the Passamaquoddy-Upper Saint John River Project. Furthermore, under the Flood Control Act of 1944, and under subsequent interpretation and practice, the Federal Government could conceivable construct such projects upon congressional authorization.

This alternative suffers in that none of the three alternative pumped storage sites have a source of dependable low-cost power available from an independent entity nor do they have the capability of self-contained power for pumping. Also, a pumped storage project, which requires 3 kilowatt hours of energy to produce 2 kilowatt hours would need outside power daily while Passamaquoddy is dependent upon offpeak generation for pumping for only a few days each month. Nor does pumped storage offer equivalent benefits in water resource development, flood control, river regulation, area redevelopment, and outdoor recreation.

--<u>Summary of Alternatives.</u> None of the three economic alternatives--Federal steam, Federal nuclear, or Federal pumped storage--offers the equivalent in new employment and sustained economic opportunity.

Also, intrinsic in the Passamaquoddy-Upper Saint John River Project is the concept of an international intertie between the United States and Canada in the Northeast whereby the full economic potential of each nation could be fully realized to mutual maximum benefit.

An intertie which possibly will be similar in concept to the Pacific Northwest-Pacific Southwest Intertie--an 11 state joint Federal, state, local, and private electric transmission system recently endorsed by President Johnson "as the launching of a new era of cooperation between private power and public power in the United States." This system, effecting large economies, shared by private and public power alike, will also be used to transmit power generated in Canada resulting from the full development of the Columbia River in the Pacific Northwest.

Ignoring the other inherent limitations of alternatives, the full development of water resources--a national goal--would be retarded through adoption of other economic alternatives.

There is no alternative to Passamaquoddy to conserve the ever-wasting energy of the tides and putting it to beneficial use.

In the ensuing years, the Department of the Interior is convinced that, in New England, the development of pumped storage, conventional hydroelectric power, modern steam generation, and nuclear plants--whether public or private--will be required. New capital investment by private industry in base-load plants will be absolutely essential.

The Department is equally convinced that the Passamaquoddy Upper Saint John River Project is a first and necessary step toward vitally needed economic rejuvenation for people whose ancestors did so much to help frame our national heritage.

<u>Does New England Need Low Cost Power?</u>

In September 1963, the Federal Power Commission reported:

"...The average cost of electricity in New England today is the highest of any region in this country and the average use is the lowest. New England is handicapped by the fact that it does not have large deposits of low cost fuel and this handicap is enlarged by the fact that the (electric power) industry in the area is only beginning to install larger and more efficient units to replace the small and relatively inefficient units which make up much of the existing power supply. This fact underscores the need for prompt development of all the economic hydroelectric sites in the region and in adjoining areas where through stronger interconnections lower cost power can serve to reduce the cost of electricity in New England..."

Power costs in New England are about 60 percent more than the national average and about 181 percent higher than in the eastern-south-central portion of the country. Massachusetts, for example, offers all of the prerequisites for attracting and holding industry--except one, reasonable electric power rates.

A New England textile manufacturer says, "If we expect industry to develop and grow in New England, these power rates must be brought in line with comparable rates charged elsewhere," adding, "we are almost forced to consider seriously the feasibility and desirability of remaining in Massachusetts. In fact, we are studying the relative merits of several locations in the South."

This manufacturer would have saved 38 percent of his total power bill if he could purchase electricity at the national average rate. His power bill is 55 percent higher than in one city and an astounding 144 percent higher than in another. Over a ten-year period, this one firm could save a minimum of $240,000 and a maximum of $420,000 in power costs alone by leaving Massachusetts.

The Tides as an Energy Source

In contemplating the potential of Passamaquoddy, it is important to recognize that the tide is a perpetual energy source, fully predictable and dependable, and never in danger of drying up.

The level of the sea alternately rises and falls under the force of astronomic conditions dependent on the relative positions of the sun, earth and moon. The height of the tide varied with these forces and the physical make-up of the coastline. The greatest rise and fall of the tides in the world occur in the head of the Bay of Fundy, on the Nova Scotia coast, where tides as high as 40 to 50 feet occur. Passamaquoddy Bay is a bay of about 100 square miles off the Bay of Fundy. Here tidal range varies from a maximum of 26 feet to a minimum of 12.7 feet, with an average tidal range of 18.1 feet. There are generally two complete tidal cycles, that is, two high tides and .wo low tides, each day. This is the case in the Passamaquoddy Bay area.

To produce electric energy from water requires water falling from a higher elevation to a lower elevation and passing through turbines which spin generators. To utilize the tides for production of electric power and to assure having power when it is needed require storage to hold back large quantities of water at high tide for release through turbines at low tide. The job can be done with a single large pool regulated by filling gates, but in such event power can be produced only at those times in the tidal cycle when the difference between the elevation of the pool and the ocean is sufficient for operation of turbines. A combination of two storage pools, however, one to store incoming tide waters at a high level and the other at low level with gates to keep the high tides out, coupled with reversible pump turbines, can make possible generation to meet any two-hour peak load any day of the year.

Basically, the operation of the tidal power project involves the filling of the Passamaquoddy Bay with an area of about 100 square miles as the tide rises. This Bay is held in a filled condition until water releases are required to meet a peak power load. The water is released quickly through the generators into a lower pool. The lower pool is emptied into the sea at such times as the sea level is below the level of the pool. The turbines are operated during the off-peak hours so as to enable the maximum generation of firm energy with the integrated operation at the Dickey site and in the generation of a large bulk of off-peak energy.

The only tidal development for electric power under full-scale construction today is the La Rance Tidal Project in France. The Russians also have plans for utilizing the tides to produce electric power also. Passamaquoddy represents the first and best chance for the United States to make a practical beginning in this new field of energy production.

Quoddy for Peaking

The electric utility load pattern for the New England-Maritime Provinces area has had only one sharp peak each day. It occurred approximately between 5 and 6 p.m. and on load curves is so pronounced that it can be described more properly as a "spike" rather than a "peak".

The basic operating plan for Passamaquoddy as a "peaking" power plant is this:

During the high tide prior to a peaking period, the high pool is filled to the highest possible elevation. Similarly, during the low tide prior to a peaking period, the low pool is emptied to the lowest possible elevation. These pool elevations are then maintained until the start of the peaking period when water from the high pool is dropped through the power plants to the lower pool. Water accumulated in the lower pool then is released to the ocean through emptying gates whenever the Ocean tides are below the level in this pool.

Following the peaking period, off-peak or secondary energy then can be produced until the time and tides are such that the pools must be refilled or emptied in preparation for the next peaking period.

By itself, the hydro project at the Dickey site could produce only about 150,000 kilowatts of dependable 60 percent load factor power. Integrated with off-peak Passamaquoddy power, it can produce 250,000 kilowatts of dependable load factor power.

The Dickey power plant would not, by itself, be able to use all of the off-peak power available from Passamaquoddy for integration into a firm energy pattern. This means off-peak Passamaquoddy power would be available for integration with other potential hydro projects in the area.

Recreation Benefits

Passamaquoddy and Cobscook Bays offer a panorama of water and scenic views complemented by the Fundy Isles of Campobello, Deer Island and Grand Manan, all located in Canada.

The principal attraction to tourists would be the tidal power project itself, featuring ocean dams 7 1/2 miles in total length. An engineering marvel, its operations would feature the rise and fall of the tides, the impounding of water in two natural pools, navigation locks for unrestricted movement of boats, emptying and filling gates, and power transmission.

Many hundreds of thousands of persons who now visit other parks and attractions in the general area doubtless would make a stopover at Passamaquoddy which will attract additional hundreds of thousands of visitors. This would greatly benefit the area, particularly Washington County, headquarters of the proposed project. This country now has the lowest median income of any county in Maine.

The Bureau of Outdoor Recreation estimates that present visitations to the Passamaquoddy area total about 216,000 visitor days and would be 500,000 visitor days by 1975, increasing to more than 4 1/2 million visitor days by the year 2025. The conservative recreational value of only 80 cents per visitor day in arriving at average annual recreational benefits of $2,065,000.

Because of the unique nature of the Passamaquoddy Tidal Project and its potential attraction for travellers, the project development will include a visitor center with adequate parking facilities, picnic areas, boat launching sites at convenient locations, frequent roadside overlooks and interpretive sights at appropriate points.

Representative statistics on recreational use of several water resource projects in other parst of the Nation are as follows:

Project	State	Total Visitor Days 1962
Shasta Dam	California	5,209,923
Hoover Dam	Arizona-Nevada	3,200,739
Colorado-Big Thompson	Colorado	1,593,653
W. C. Austin Dam	Oklahoma	1, 295,079
Elephant Butte	New Mexico	1, 210,000

Saving The Allagash

Located deep in the backwoods of Maine, the Allagash River flows northward for nearly 100 miles through forests of spruce-fir, maple, and birch. Linked by quiet lakes of tranquil beauty, the Allagash River has long been hailed by outdoor enthusiasts as one of the major primitive river courses in the United States. A traditional canoe trip in the Allagash is regarded as a classic canoeing experience by many who have made the journey.

It is one of the few remaining free-flowing streams of importance in the eastern United States--a major recreation resource of great potential significance to the Nation.

Throughout the country, water resources are being extensively developed and utilized. Many natural rivers already have been irrevocably committed to uses which leave little room for the fundamental pleasures associated with the natural environment. In view of this trend, wild and semi-wild rivers such as the Allagash become increasingly important from the standpoint of retention for present use, as well as comparable use by future generations.

If the Allagash is not preserved, it will mean that the Nation has lost access to an adventuresome outdoor experience which it has treasured since early times.

The purpose of an Allagash National Riverway, proposed by Secretary Udall, would be to insure an area in the eastern United States of sufficient size and quality where present and future generations may experience a primitive northwoods canoeing adventure.

Although isolated by nature, the Allagash offers a richly-rewarding experience to visitors willing to expend the effort to explore the area. In this land of primitive river travel, they find a superb environment and reap the lasting satisfaction of enjoying a form of recreation gradually disappearing from the national scene.

The Allagash River drains a watershed which for more than one hundred years has been dedicated to the growth and harvest of timber. Since wood resources are of importance to the area, the final plan designed to protect the unique recreation resources would allow harvesting of the timber resources except immediately adjacent to the waterways.

Summary

Today, when we say Quoddy, we are not speaking about the project envisioned by Dexter Cooper in 1919, nor the project conceived by President Roosevelt in the 1930's, nor even the project studies by the International Joint Commission from 1956 to 1961. We are talking about an entirely new project that only shares a common name. We have moved almost overnight into a new era of engineering technology and sustained and growing demand for low-cost energy.

If America's economy is to expand--as it must to provide new jobs, to eliminate poverty, and to create a rising standard of living--adequate power at reasonable rates is a basic and solemn obligation of the power industry--public and private alike. To have a first rate economy we must have a first rate power system. Potentially lower power costs are possible through adequate interconnections of electric systems, the maximum development of hydroelectric power, and utilization of revolutionary new technology. The Federal government has a responsibility for providing leadership in this area of endeavour.

Quoddy is conceived to meet the new needs of our time. Through the orderly development of the water resources of Passamaquoddy Bay and the St. John River large benefits will accrue to Canada and the United States.

--A new source of relatively low-cost power will be created in an area where average electric costs are the highest in the Nation. Canada's share of the project power, plus the greater utilization of the St. John, will be significant value to New Brunswick's future.

--Flood control on the St. John will assist in reducing the flood damage to property in Maine and New Brunswick.

--Improvements in navigation will result in Passamaquoddy and Cobscook Bays.

--Recreation and tourism will be enhanced. The Allagash River will not be flooded, picnic and boating areas will be provided around Dickey, and an estimated one million tourists a year will be drawn by Quoddy. Already, visitors are coming to Eastport even before construction has started.

--Fully ninety percent of the cost of the projects will be repaid, with interest, within 50 years, and after repayment both Quoddy and Dickey will have many years of usefulness at no cost except operation and maintenance.

--Quoddy's dams offer a unique opportunity for a new modern highway system linking Maine and New Brunswick.

--The knowledge and experience gained at Quoddy will be of great value in developing tidal powerplants elsewhere--as well as on the Bay of Fundy. This is not only important to Cánada, but to the United States and other countries around the world.

--Finally, and perhaps the greatest benefit on which we can place no dollar value: The United States and Canada again demonstrating to the world that two peaceful democracies can work side by side in making a better life for all of their people.

Growth is a never-ending process which depends ultimately on the use we make of all our natural resources. We cannot allow ourselves to relax our efforts for the optimum development of our natural resources. A resource has no value unless it makes a productive contribution to the material or spiritual needs of mankind. Passamaquoddy meets this conservation test.

We believe there is a place in New England for all elements in the power program--Federal, cooperative, municipal, private--each has a legitimate role to play. This is sound conservation doctrine--and good common sense.

Conservation is the highest form of national thrift. Only by new and imaginative decisions can our nation prosper. The Department of the Interior, a major conservation agency of the Federal Government, is devoted to the principle that expendable resources should be conserved, that renewable resources should be managed to produce maximum benefits, and that all resources should contribute their full measure to enrich the lives of all Americans...Now and in the future.

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In its assigned function as the Nation's principal natural resource agency, the Department of the Interior bears a special obligation to assure that our expendable resources are conserved, that renewable resources are managed to produce optimum yields, and that all resources contribute their full measure to the progress, prosperity, and security of America, now and in the future.

U.S. Department of the Interior